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AUTHOR Iaccino, James; And Others
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ABSTRACT

To determine whether concealed imagery was an effective mnemonic aid in the recall of paired objects, two studies were conducted with explicitly worded instructions to conceal targets and with variable image formation periods. In each study, 40 subjects were presented with counterbalanced verbal descriptions of Concealed, Pictorial, and Separate object interactions; the descriptions were further categorized according to the type of image elicited, whether Normal or Bizarre. Results of Experiment 1 showed that speed demands forced subjects to form concealed images rapidly, with a subsequent detrimental effect on their recall, particularly in the Bizarre Concealed condition. When more time was allowed for image construction and processing, the pattern of findings changed dramatically in Experiment 2: Bizarre Concealed images were recalled just as well as Pictorial ones. In support of N. H. Kerr and U. Neisser (1983), the mnemonic effectiveness of these images is determined by their formation times rather than by instructions to conceal. (Four tables of data are included, and 22 references are attached.) (SR)

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Mental Layouts of Concealed Objects as a Function of Bizarre Imagery and Retention Interval

James Iaccino, James Byrne, and Lori Dielke

Illinois Benedictine College

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Running Head: CONCEALED IMAGERY

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Abstract

We determined whether concealed imagery was an effective mnemonic aid in the recall of paired objects by conducting two studies which contained explicity worded instructions to conceal targets and variable image formation periods. In each study, forty subjects were presented with counterbalanced verbal descriptions of Concealed, Pictorial, and Separate object interactions; the descriptions were further categorized according to the type of image elicited, whether normal or bizarre. Results of Experiment 1 showed that speed demands forced subjects to form concealed images rapidly, with a subsequent detrimental performance on their recall, particularly in the Bizarre Concealed condition. When more time was allowed for image construction and processing, the pattern of findings changed dramatically in Experiment 2: Bizarre Concealed images were recalled just as well as Pictorial ones. In support of Kerr and Neisser (1983), the mnemonic effectiveness of these images is determined by their formation times rather than instructions to conceal.

Mental Layouts of Concealed Objects as a Function of Bizarre Imagery and Retention Interval

It might not be appropriate to describe images as "pictures in the mind's eye." According to Gibson (1966, 1979), images correspond more to mental layouts than mental pictures; in other words, images represent more than just the picture plane. Gibson claimed that perceptions of objects can still continue even after they are no longer visible. Thus, images can represent the entire structure of a three-dimensional environment, including objects that are temporarily concealed.

At this point, the concept "visual image of a concealed object" might require more explanation. Does the image allow the subject to actually "see" the object? Past research (Neisser & Kerr, 1973) has demonstrated that some subjects reported they could see through into the concealed place with something like Superman's X-ray vision. Others mentally changed their perspective and moved into the concealed place, and thus were able to view the object. Other subjects, however, reported they did not really have an image of the concealed object but somehow spatially <u>knew</u> it was there, indicating that

mental seeing is not a necessary component in the construction of concealed images.

Some researchers (Keenan & Moore, 1979) are of the opinion that as long as subjects are able to view the hidden objects as though they were visible, then the criterion for proper concealment has not been met. Without specific experimental instructions given to subjects to construct images that actually concealed objects, one would not anticipate a difference between recall of these items from ones within a visible, pictorial plane.

The current view pertaining to concealed imagery, as posited by Keenan (1983) and Kozminsky (1981), is that subjects need special training to actually visualize scenes exactly as described to them. Otherwise, they might change the spatial arrangements of the objects, mentally seeing and feeling concealed items as though they were truly visible.

To test the mnemonic effectiveness of concealed imagery, the typical experimental design has had subjects construct images corresponding to sentences that described pairs of objects. Three types of sentences have been employed: pictorial, concealed, and separate. The first condition,

Pictorial, described objects that were visible and interacting with each other; for example, "On the top of a cannon, glittering in the sunlight, there is a rare coin." The second condition, Concealed, also specified an interactive relation between the objects; however, one of the items was hidden inside or behind the other so that the object could not be portrayed in the picture plane; for example, "Deep inside the pitch dark barrel of the cannon, there is a rare coin." Finally, the third type of condition, referred to as Separate, described both objects as being spatially distant from each other; for example, "On the river bank of Arlington National Cemetery sits an old cannon. Directly across the river on display at the U.S. Treasury, there is a rare coin." The Separate condition was a necessary control to determine if objects not in interaction were less well remembered than those in an interactive relation (Wollen, Weber & Lowry, 1972).

Subjects were timed as they constructed each image. They were also asked to rate the vividness of each image on an 7-point scale, extending from most vivid (1) to least vivid (7). An unexpected recall test was administered immediately after all the sentence pairs were

presented. The setting of each scene was provided (e.g., "cannon in Arlington National Cemetery") and subjects had to recall the target object that had visibly interacted with, was concealed from, or was separated from the other object (in this case, "coin").

The results obtained from these designs have been inconsistent. With respect to the recall data, Concealed objects were remembered just as well as Pictorial ones when subjects were given no instructions to conceal (Keenan & Moore, 1979; Kerr & Neisser, Experiment 1, 1983; Neisser & Kerr, 1973). When explicit instructions were provided in the strongest wording possible, a different pattern was shown: recall of Pictorial images was best while Concealed images were remembered no better than the Separate (Keenan & Moore, 1979; Kozminsky, 1981; Zimler & Keenan, 1983). Instructions apparently reduced or eliminated the visibility of Concealed objects, making them less memorable than the Pictorial.

Another variable that apparently interacted with instructions was time pressure in the formation of the images. If there were strong demands for speed and rapid responding, then recall in the Concealed condition significantly declined in comparison with the Pictorial

(Kerr & Neisser, Experiment 4, 1983). It might be that Concealed images needed to be more thoroughly developed, and that time was necessary to fully elaborate these spatial layouts.

If these subjects, however, were able to leisurely imagine the scenes even when instructions were provided, then the Concealed condition was just as mnemonically effective as the Pictorial (Kerr & Neisser, Experiments 1, 2 and 3, 1983). As Keenan (1983) posits, subjects might have been using more elaborate strategies across time to hide the "concealed" objects in order to compensate for their lack of visibility, making the two conditions comparable in recall performance. However, these latter findings have not been consistently replicated, and several researchers still assume that recall is mainly dependent on the type of image instructions provided to subjects (Keenan, 1983; Kozminsky, 1981; Zimler & Keenan, Experiment 3, 1983).

Speed demands seemed to have their greatest effect on image formation time per se. Kerr and Neisser (Experiment 4, 1983) emphasized time with the following procedure: subjects were told they would be measured on "how quickly" they could create visual images, and a

digital clock counter to measure the response times was plainly visible to these subjects. The mechanism was activated whenever a description was completed and stopped when subjects had formed their image. These researchers found that response times across all conditions were dramatically shortened, with Pictorial and Concealed images being formed faster than the Separate. Keenan (1983) suggests that when subjects realize their imaging times are being measured, they respond faster but show subsequently poorer recall of Concealed objects.

In terms of the vividness ratings, the findings once more have not been in agreement. Neisser and Kerr's experiments of 1973 as well as those of Keenan and Moore's (1979) showed that Concealed images were rated as less vivid than the Pictorial. However, in more current studies (Kerr & Neisser; Experiments 1, 2 and 4, 1983), a different pattern emerged: Concealed images were just as clear as Pictorial, with the Separate ones being the least vivid. Instructions to conceal particular objects presumably affected the rated vividness of these items. The wording of the instructions might have placed a greater emphasis on the objects' visibility or invisibility, thus heightening or lowering the ratings respectively. Since

imagery vividness was affected by these demand characteristics (see Sheehan & Neisser, 1969), the more objective measures of recall and formation time have been focused on to test the effectiveness of Concealed imagery.

Now in all of these designs, the effects of bizarre imagery have not been controlled. Some sentence frames did not depict the typical, commonplace interaction between the objects. For example, unusual Pictorial and Concealed frames used in Neisser and Keer's studies (1973, 1983) consisted of the following: "A harp is sitting on top of the torch held up by the Statue of Liberty; "Buried beneath a snowbank, there is a clock." Even historical figures and cartoon characters (Zimler & Keenan, 1983) were involved in some of the image scenes; "A revolver is inside the breast pocker of Napoleon's coat" or "There is a cement truck locked inside Charlie Brown's garage." Though some researchers (Wollen, Weber & Lowry, 1972) believed that recall performance was affected by the interaction between the elements of the image and not their bizarreness, the influence of this variable on concealed imagery per se has never been determined and thus, requires further investigation.

Research findings involving this type of imagery under Pictorial conditions have shown that bizarre interacting pairs did not exert a significant effect on immediate recall of the paired-associates; in fact, the normal commonplace scenes aided memory retrieval (Collyer, Jonides & Bevan, 1972; Nappe & Wollen, 1973). However, when unexpected recall was delayed by intervals ranging from 24 hours to 2-week periods to even lengthier 15-week durations, bizarre images facilitated retention relative to the normal types (Andreoff & Yarmey, 1976; Delin, 1968; Iaccino & Spirek, 1988; Merry, 1980; Merry & Graham, 1978). These effects with bizarreness would appear to tentatively support O'Brien and Wolford's (1982) stimulus distinctiveness theory, which states that bizarre types of images increase the saliency of the pictorial elements across time, contributing to less confusion and less interference among these stimulus pairs and eventually leading to their more accurate recall.

Image formation times have also been affected by bizarreness. Studies have consistently shown that normal images were formed faster than bizarre types, and that this speed advantage was maintained over several experimental sessions (Hauck, Walsh & Kroll, 1976; Nappe & Wollen,

1973). Researchers have speculated that because bizarre images took longer to form, they were a less efficient type of mnemonic. Another alternative might be suggested, namely, that bizarre as well as Concealed images required more time for their development in order to achieve their full mnemonic effectiveness.

Though not directly tested with bizarreness, vividness ratings were assumed to be lower under this type of imagery. For instance, if the scene consisted of an extremely unusual interaction ("giant prehistoric butterflies housed in a cave"), the resultant image would presumably be very vague due to the subject not having an exact referent to reality when forming the mental layout. However, according to the stimulus distinctiveness theory, the vividness of bizarre images would change as a function of time — in fact, be heightened as longer delays occurred between stimuli presentation and their recall.

Based on these findings, the following set of hypotheses were formulated for Experiment 1. For bizarre types of imagery, (a) recall on immediate tests would be poorer than with normal types, (b) image formation times would be slower relative to the normal, and (c) vividness ratings

would be lower. With respect to the three conditions (i.e., Pictorial, Concealed, and Separate), a replication of Kerr and Neisser's (1983) results were anticipated provided strong instructions to conceal appropriate objects and speed demands were emphasized; specifically, (a) Concealed and Separate immediate recall would be poorer than Pictorial, (b) Concealed formation times would be just as fast as the Pictorial, and (c) Concealed and Pictorial images would be rated equally vivid. Separate images would be less vivid and formed more slowly than the other two conditions.

An interaction between image type and conditions was also hypothesized, with a similar conditions pattern occurring under both bizarre and normal imagery. However, the normal types would still be more effective than the bizarre in terms of recall, formation times, and rated vividness on immediate tests. In addition, a procedural variation would be introduced in this first study. Scenes depicting pictorial, concealed or separate objects would be rated initially on their level of bizarreness, and those with the most extreme ratings would be employed in the main desing to ensure appropriate differentiation between bizarre and normal types of images.

Experiment 1

Method

Subjects. Forty male and female students from Illinois Benedictine Collage at Lisle participated for credit toward a course requirement in psychology. They were not preselected for ability to image.

Materials. Materials consisted of 80 high-imagery nouns, ranging from 6.20 to 6.80 on the I scale of the Paivio, Yuille and Madigan (1968) word lists. These nouns were also high in concreteness and most especially meaningfulness. The items selected were arranged to form 40 pairs of words that were described in sentences. The first sentence had the stimulus term of each pair while the second sentence connected the stimulus to the response term. The second sentence also described the response term (or target object) as Pictorial, Concealed or Separate. The Pictorial condition visibly related the target to the stimulus term in the initial sentence; the Concealed version also related both terms, but the target object was obstructed or hidden from view; finally, the Separate version described the target as spatially set apart from the stimulus. Sentences under each condition

were approximately equal in length (average length = 12 words). Care was taken in positioning the target word as close to the end of the second sentence as possible without losing coherency. It should be noted that proper nouns were not part of the scenes since these items were never equated in terms of imagery value; hopefully, this was an improvement over previous methodologies that had employed such materials.

Approximately 200 subjects were given the 40 descriptive pairs of sentences in all three versions and were asked to rate each version on a five-point scale, extending from most normal (1) to most bizarre (5). Half of the subjects rated the bizarre versions while the reamining members read the normal types and assigned values to these scenes. Examples of the sentence pairs are provided in Table 1.

Insert Table 1 about here

An overall rating was obtained for each subject. Rank-order correlations were subsequently performed on these averages when the groups were split-halved by image type. The resulting coefficients were .65 and .73 for the normal

and bizarre types of sentences respectively, suggesting a very high degree of agreement among the subjects. Mean ratings across subjects were 1.75 for the normal pairs and 4.34 for the more bizarre pairs.

Design. From the 40 sentence pairs, 18 were selected and used in the main study. These pairs elicited the highest degree of consistency among raters, as evidenced by their most extreme values. Each subject received the initial sentence frame; however, only one version of the second sentence was provided. Six versions were descriptive of the Pictorial condition, six descriptive of the Concealed condition, and six descriptive of the Separate. To prevent primacy and recency effects, three buffer pairs preceded and followed the 18 experimental sentences. These six buffers were not included in the recall test nor in the data analysis.

Descriptions were crossed with conditions in a counterbalanced pattern; for example, one subject was told to imagine a cabin directly in the path of an avalanche, another had to imagine a cabin buried under the avalanche, while a third was given the scene of a cabin sitting atop a neighboring mountain.

Counterbalancing was done to ensure that any differences across conditions could not be attributed to differences in memorability of the sentence pairs. The 12 counterbalanced presentation orders were similar to ones used in Neisser and Kerr's (1973) study: 8 with four subjects each and 4 with two subjects each.

Subjects were further subdivided in terms of the sentences' image type: 20 were given normal descriptions whereas 20 received the bizarre scenes. The target words were presented in the same order for all subjects, and on subsequent recall, the 18 scenes were provided in the same order. The stimulus term served as a cue for the recall of the target object. The 18 target responses to be remembered consisted of the following: ambulance, beaver, book, bullet, butterfly, candy, caterpillar, cigar, corn, doctor, gem, gold, hammer, lobster, plank, string, thorn, and wine. The type of design employed was a 2 by 3 factorial combination of image type (normal vs. bizarre) and conditions (Pictorial, Concealed and Separate), with conditions being a within-subjects factor.

Procedure. Subjects were tested individually. They were told that they would hear a series of 24 narrated scenes and should try to imagine each scene exactly as described to

them. Subjects were also informed to form their images "as quickly and as vividly" as possible. To emphasize the speed of response times, the experimenter timed subjects with a stopwatch that was plainly visible. After image formation times were recorded, subjects were asked to rate each image on an 7-point scale extending from perfectly clear and vivid (1) to completely vague and dim (7). The scale was a shortened form of the Betts' Questionnaire on Mental Imagery adapted by Sheehan (1967).

Instructions to conceal particular target words were also provided:

> Now, some of the narrated scenes will describe objects that are concealed. For example, an object might be inside, under or behind another object. It is very important that you imagine the scenes exactly as I describe them to you. For example, if I read you the description, "A huge avalanche of snow rumbles down the mountain. Buried beneath the tons of avalanche there is a rustic cabin," you should imagine the scene exactly as described with the cabin beneath tons of snow on top. You should not be able to see the cabin at all. Do not try to see the concealed

> object. For any description, do not change the spatial arrangements in any way. Just mentally visualize the objects as you would be viewing them in the real world.

These instructions were similar in format to those of Kerr and Neisser's (1983). Practice descriptions with all three conditions were given so that subjects understood the task. After the practice concealed sentence was provided, subjects were asked a probe question about the target object. If the target could be described, subjects were severely reprimanded and told that if they continued visualizing concealed items in this way, the experiment would be terminated and extra credit points would not be obtained. These warnings were used to ensure that subjects were trained properly in the formation of concealed images.

The 24 descriptions immediately came after these practice conditions. The scenes were read one at a time; than an unexpected recall test followed. The experimenter gave each of the 18 stimulus terms and asked subjects to describe in detail as much of the image containing the stimulus term as possible. If subjects could not recall their image, additional prompts proved necessary; for example, "I want you to think once more about the scene associated with this term. Try to

recall any part of the scene. If you can just remember one or two words, report them." The experimenter recorded a response as correct if the target object or an approximation to the target was supplied. A post-experimental session was then conducted with each subject in which the purpose of the study was revealed.

Results

Accuracy of Recall. With respect to mean recall of response items on immediate testing, a 2 x 3 (image type x condition) analysis of variance yielded a significant main effect involving conditions, F (2,76) = 3.42, MS_e = .03. Pictorial images were recalled better than either Concealed or Separate ones. Newman-Keuls pairwise comparisons showed that Pictorial mean recall was different from both Concealed and Separate, 5.06 in comparison to 3.42 and 3.13. The latter two conditions, however, did not differ from each other.

A main effect of image type was also found, F (1,38) = 10.18, MS_e = .79, with normal images benefiting recall more than bizarre ones. The respective means were 4.43 and 3.57. Finally, the Image Type x Conditions interaction revealed that Pictorial recall was better than Concealed and Separate under both normal and bizarre images, F (2,76) = 4.54, MS_e = .03.

Insert Table 2 about here

Latency to Form Images. A similar analysis of variance was performed on the time it took subjects to form an image in each condition before testing. A highly significant effect of conditions on image formation time was found, F (2,76) = 9.53, MS_e = 2.54. Paired comparisons indicated that Separate images were formed more slowly than either Pictarial or Concealed ones, which did not differ. Means for the three conditions (in sec) were 4.26, 3.62 and 3.45 respectively. Also, bizarre images had longer latencies than normal as evidence by the high level of significance involving type, F (1,38) = 14.98, MS_e = 3.12.

The Type x Conditions interaction demonstrated that Pictorial and Concealed formation times were faster than Separate under both image types, F (2,76) = 16.12, MS_e = 2.54.

Insert Table 3 about here

Moreoever, Newman-Keuls analyses showed that all normal images were constructed significantly more quickly than the corresponding bizarre types, with the Bizarre Separate having the longest formation time.

Rated Vividness of Images. The three conditions also differed significantly in vividness, F (2,76) = 6.92, MS_e = .65. Pairwise comparisons fell into the same pattern as for immediate recall. Pictorial images were rated as more vivid than either Concealed or Separate ones, which did not differ. As in the previous analyses, an image type effect was found with bizarre images being less vivid than normal types, F (1,38) = 6.54, MS_e = .15.

Insert Table 4 about here

Finally, the interaction revealed that normal and bizarre Pictorial images were rated the most vivid, F (2,76) = 7.51, MS_e = .65. The least vivid of all conditions was the Bizarre Concealed, as indicated by pairwise comparisons.

Discussion

To summarize the major findings of Experiment 1, recall of target items was poorer under Concealed conditions than Pictorial while image formation times were equivalent in both conditions, replicating the results of Kerr and Neisser (1983). Moreover, the pattern for Separate images was repeated. A discrepant outcome was that the vividness of Pictorial imagery was rated higher than Concealed; however, as previously

indicated by Sheehan and Neisser (1969), strongly worded instructions to conceal particular targets could have had the effect of making the objects less visible and subsequently less vivid.

With respect to bizarre types of images, the experimental hypotheses were supported: poorer recall of targets, slower formation times, and lower vividness ratings were all obtained relative to the more normal types. More specifically, recall of Bizarre Concealed targets was very poor and the vividness of this particular imagery was the lowest rated of all conditions. It would appear that objects that were concealed within a bizarre layout were adversely affected by the task demands in this experiment. Due to the time constraints imposed on subjects and the emphasis on concealment, images of these targets were formed very quickly, in fact, just as fast as Pictorial ones. However, more elaborate processing of the target items could not occur because the subjects' responses were so rapid.

Experiment 2 was designed to further test the mnemonic effectiveness of bizarreness and concealment when a lengthy retention interval was employed between presentation of the sentence pairs and recall of the target objects. Unlimited image formation times were also provided to allow subjects to expand these spatial layouts. Instructions to conceal

particular objects were emphasized once again to prevent any direct visualization of the targets within the Concealed condition.

We predicted that bizarre images would facilitate recall and their vividness would be just as clear as (if not greater than) normal types. Since there were no time constraints in this experiment, Concealed recall would also improve relative to Pictorial, replicating previous results (Kerr & Neisser, Experiments 1, 2 and 3, 1983). Possibly heightened vividness of Concealed images would occur as a byproduct of unrestricted formation time. The major hypothesis to be tested was that the retention interval would produce better recall of Bizarre Concealed images relative to other types.

Experiment 2

Method

Forty undergraduate students from Illinois Benedictine College, 23 female and 17 male, participated for credit toward a course requirement in psychology. The procedures of Experiment 1 were followed exactly, except in two respects. (a) Subjects were informed they had "as much time as they wanted" to construct their images. To ensure that speed was deemphasized, a second experimenter unobtrusively recorded subject formation times. (b) After the 24 sentence pairs

were presented, subjects were told to "come back the following week when another set of materials would be provided." The experimenter explained that the vividness ratings of particular images was of interest to the major investigators, and that more images would be rated at the next meeting. When subjects returned, they were given an unexpected recall test on the initial target objects.

Results

Accuracy of Recall. Table 2 shows that under delayed testing, Pictorial and Concealed images were recalled equally well and better than Separate ones, F (2,76) = 18.48, MS_e = 1.46. Newman-Keuls analyses indicated that Separate recall was poorer than either Pictorial or Concealed, which did not significantly differ. There was also a main effect of image type, with bizarre images being recalled more than normal types, F (1,38) = 33.06, MS_e = 3.42. These main effects were qualified, however, by a significant interaction of image type and conditions (F (2,76) = 8.73, MS_e = 1.46. The Bizarre Pictorial and Concealed conditions were recalled the best, relative to the other conditions.

An overall 2 x 2 x 3 (Image type x testing x condition) analysis of variance was performed on the recall data in

both experiments and a significant three-way interaction was found, F (2,152) = 4.73, MS_e = .39. As can be seen in Table 2, superior recall of bizarre over normal image types was obtained under delayed testing. Thus, it appears that lengthy retention intervals facilitate the recall of bizarre images.

Latency to Form Images. The average time it took subjects to construct the images before delayed recall is presented in Table 3. Image formation times replicated our original findings. Pictorial and Concealed images were constructed in equivalent periods in comparison to Separate ones which had slower times, F (2,76) = 15.21, MS_e = 1.65. Respective mean times (in sec) for the three conditions were 6.21, 6.24, and 7.10. Once again bizarre images were found to have longer latencies than normal types, F (1,38) = 28.52, MS_e = 2.47. The interaction moreover revealed a similar pattern to Experiment 1; namely, that bizarre conditions had the slowest formation times, F (2,76) = 5.27, MS_e = 1.65.

The most important finding was the interaction of image type, conditions and testing, F (2,152) = 4.86, MS_e = .94. Subjects took significantly longer to construct their images, particularly bizarre types, when unlimited time was provided.

Rated Vividness of Images. Vividness ratings apparently were not affected by formation times or delayed recall. The results for vividness were just like those of Experiment 1: Pictorial images were rated the most vivid of the three conditions, F (2,76) = 30.53, MS_e = .28; bizarre types still remained less vivid than normal ones, F (1,38) = 22.87, MS_e = .85; and the interaction revealed that the least vivid conditions were the Bizarre Concealed and Separate ones, F (2,76) = 3.58, MS_e = .28. A new finding depicted in Table 4 was that the Normal and Bizarre Concealed conditions did not significantly differ from each other. The interaction involving image type, conditions, and testing failed to reach significance, further indicating that vividness was the least influenced of the three measures in this experiment.

Discussion

The results of Experiment 2 showed that unlimited formation times and delayed testing had a pronounced effect on the recall of particular types of images, with Bizarre Concealed images being just as effective as Bizarre Pictorial ones. It was also evident that subjects formed these images much slower than when time constraints were employed. Respective mean times for Bizarre Concealed and Pictorial

images were 7.16 and 7.08 sec, in contrast to the faster times of 4.22 and 4.52 sec in Experiment 1. As hypothesized by Kerr and Neisser (1983), the mnemonic effectiveness of these images was dependent on the amount of formation time provided to construct the spatial layouts. Vividness findings did not support our predictions however. Bizarre Concealed images were not as clear as the corresponding Pictorial ones, suggesting that the retention interval was also necessary to further elaborate these layouts.

General Discussion

Our results indicate that images of concealed items within bizarre layouts can be just as mnemonically effective as pictorial ones. It would appear, however, that these spatially complex images need time for their development. If subjects believe that speed is critical after being given strongly worded instructions to conceal, elaboration of these layouts cannot occur as demonstrated by their poorer recall in Experiment 1. However, if speed is deemphasized, instructions to conceal will not have a detrimental effect on the recall of these targets (as shown in Experiment 2); subjects will still have enough time to expand on the spatial relationships of these images.

As Kerr and Neisser note (1983), "time itself is not the essential factor" (p. 219) in the image's effectiveness. Rather, what the subject does within the time period to process a layout which includes the concealed object is the all-important variable. Imaging, as well as perceiving, require additional processing time when objects are not within a pictorial plane (Gibson, 1966, 1979). It should be noted that not all images benefit from this processing. Separate images, although having the longest formation times, led to the poorest recall even when a lengthy retention interval was used to further expand the layouts.

Contrary to Keenan (1983), who speculates that the wording of instructions determines how mnemonically effective concealed images can be, the importance of formation time should not be overlooked. In both of our experiments, the same strongly worded Instructions to Conceal were administered to subjects. What did differ was the time required to process the images. And when time was manipulated, Concealed imagery either improved or deteriorated accordingly.

Some information-processing strategies will now be presented in an attempt to explain the role of time in bizarre and Concealed imagery construction. A faster,

though less efficient, strategy that could have been adopted in Experiment 1 was the rapid formation of an image without the concealed target. Since subjects knew their response times were being measured, Concealed objects were probably never imagined and thus poorer recall occurred under this condition. Bizarre targets that were supposed to be concealed would presumably be even harder to image due to the unusual nature of the interaction. Instructions to conceal the items added their impact by making the objects not only less visible but also non-existent. Use of this strategy might explain why Concealed objects in bizarre interactions were rated least vivid of all the conditions in the first study.

As Keenan (1983) suggests, if enough time was permitted for subjects to form their image, a different strategy could have been employed: namely, visualization of the concealed object before it was spatially moved into an "invisible" position. For example, subjects would first visualize the cabin being buried under the avalanche and then mentally cover the cabin up completely with snow. With this strategy, Concealed targets would be visualized just as much as Pictorial until the end of the imaging period, and subsequent

recall under both conditions would be equally effective. Due to speed demands, however, this slower (though more efficient) strategy could not be adopted until the second Experiment.

This visualization strategy might also apply to bizarre types of imagery. Namely, the unusual interaction between elements could have allowed for more direct visualization of the concealed object over a period of time. For example, subjects would not only see the rustic cabin being buried underneath tons of snow, but also begin to visualize the cabin crying for assistance. This "crying cabin" image would persist, gaining in clarity and vividness over time. When the recall test finally arrived, subjects would mentally bury the "traumatic" cabin under the avalanche, rendering it invisible in an effort to follow the experimental instructions. However, since the cabin had been mentally viewed for a considerable period, the image would be recalled just like a pictorial one.

With all these strategies, a common denominator can be identified: time to mentally distinguish invisible objects and bizarre interactions from more normal types. Even the stimulus distinctiveness theory (O'Brien & Wolford, 1982) indicates that facilitatory effects with bizarre images only occur under extended delay intervals. Therefore,

the layout differentiation theory can be advanced by these researchers. In brief description, Concealed as well as bizarre layouts are different from nomral Pictorial ones in terms of visibility and interaction between the elements. Thus, more elaborate processing of these images is required. Concealed targets need to be viewed pictorially before they can be rendered less visible. Bizarre scenes have to be related to more normal ones before they can be imaged as unusual and distinctive. And this differentiation of Concealed and bizarre layouts from normal types involves a good deal of time before these mnemonic aids can be effective, as demonstrated in Experiment 2.

The relevance of these findings should be commented on. First, we can learn more about the image process per se. To say that an image is a mental picture is too simplistic; though picture metaphors have guided the thinking of many investigators, images should not be viewed entirely in terms of such visual codes. Even Pylyshyn (1973) remarks that imagery systems are based on mental constructs less concrete, namely abstract propositions. The process of converting normal Pictorial images to bizarre layouts involving concealed items

definitely shows this abstract type of coding which takes time to develop. Second, we can identify which imagery systems are more effective mnemonic aids in recalling information, and we can subsequently manipulate certain variables such as image formation time in order to make these systems even more efficient processors.

References

Andreoff, G.R., & Yarmey, A.D. (1976). Bizarre imagery and associative learning: A confirmation. Perceptual and Motor Skills, 43, 143-148.

Collyer, S.C., Jonides, J., & Bevan, W. (1972). Images as memory aids: Is bizarreness helpful? American Journal of Psychology, 85, 31-38.

Delin, P.S. (1968). Success in recall as a function of success in implementation of mnemonic instructions. Psychonomic Science, 12, 153-154.

Gibson, J.J. (1966). The senses considered as perceptual systems. Boston: Houghton Mifflin.

Gibson, J.J. (1979). The ecological approach to visual perception. Boston: Houghton Mifflin.

Hauck, P.D., Walsh, C.C., & Kroll, N.E. (1976). Visual imagery mnemonics: Common vs. bizarre mental images. Bulletin of the Psychonomic Society, 7, 160-162.

Iaccino, J.F., & Spirek, P. (1988). Long-term retention of plausible vs bizarre paired associates as a function of cued recall. Perceptual and Motor Skills, 67, 531-537.

Keenan, J.M. (1983). Qualifications and clarifications of images of concealed objects: A reply to Kerr and Neisser. Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 222-230.

Keenan, J.M., & Moore, R.E. (1979). Memory for images of concealed objects: A reexamination of Neisser and Kerr. Journal of Experimental Psychology: Human Learning and Memory, 5, 374-385.

Kerr, N.H., & Neisser, U. (1983). Mental images of concealed objects: New evidence. Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 212-221.

Kozminsky, E. (1981). Retrieving concealed objects. Unpublished manuscript, Department of Education, Ben Gurion University of the Negev, Beer Sheva, Israel.

Merry, R. (1980). Image bizarreness in incidental learning. Psychological Reports, 46, 427-430.

Merry, R., & Graham, N.C. (1978). Image bizarreness in children's recall of sentences. British Journal of Psychology, 69, 315-321.

Nappe, G.W., & Wollen, K.A. (1973). Effects of instructions to form common and bizarre mental images on retention. Journal of Experimental Psychology, 100, 6-8.

Neisser, U., & Kerr, N.H. (1973). Spatial and mnemonic properties of visual images. Cognitive Psychology, 5, 138-150.

O'Brien, E.J., & Wolford, C.R. (1982). Effect of delay in testing on retention of plausible vs. bizarre mental images. Journal of Experimental Psychology: Learning, Memory, and Cognition, 8, 148-152.

Paivio, A., Yuille, J.C., & Madigan, S.A. (1968). Concreteness, imagery and meaningfulness values for 925 nouns. Journal of Experimental Psychology Monograph Supplement, 76, (1, Pt. 2).

Pylyshyn, Z.N. (1973). What the mind's eye tells the mind's brain: A critique of mental imagery. Psychological Bulletin, 80, 1-24.

Sheehan, P.W. (1967). A shortened form of Bett's questionnaire upon mental imagery. Journal of Clinical Psychology, 23, 386-389.

Sheehan, P.W., & Neisser, U. (1969). Some variables affecting the vividness of imagery in recall. British Journal of Psychology, 60, 71-80.

Wollen, K.A., Weber, A., & Lowry, D.H. (1972). Bizarreness versus interaction of mental images as determinants of learning. Cognitive Psychology, 3, 518-523.

Zimler, J., & Keenan, J.M. (1983). Imagery in the congenitally blind: How visual are visual images? Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 269-282.

Table 1

Sample Sentence Conditions as a Function of Image Type

Image Type	Sentence
Normal	
Basic Frame	A huge avalanche of snow rumbles down the mountain.
Pictorial	Directly in the path of the huge avalanche lies a rustic cabin.
Concealed	Buried under the tons of the avalanche, there is a rustic cabin.
Separate	On the opposite mountainside away from the avalanche sits a rustic cabin.
Bizarre	
Basic Frame	A huge avalanche of snow rumbles down the mountain

Table continues.

Pictorial	And the avalanche is stopped in its tracks by a rustic cabin.
Concealed	Directly under the tons of avalanche, a rustic cabin cries for help.
Separate	And the avalanche tries to find a rustic cabin lying far away.

Table 2

Mean Number of Items Recalled as a Function of Image Type, Conditions, and Testing

	Conditions		
Testing	Pictorial	Concealed	Separate
Immediate[a]			
Normal	5.13	3.98	3.70
Bizarre	4.99	2.86	2.57
Delayed[b]			
Normal	0.45	0.55	0.15
Bizarre	1.95	1.60	0.30

Note. Maximum score for each condition = 6.00

[a]Experiment 1. [b]Experiment 2.

Table 3

Average Time to Form Images (in sec) as a Function of Image Type, Conditions, and Testing

	Conditions		
Testing	Pictorial	Concealed	Separate
Immediate[a]			
Normal	2.72	2.77	3.55
Bizarre	4.52	4.22	4.97
Delayed[b]			
Normal	5.35	5.33	6.67
Bizarre	7.08	7.16	7.53

Note. [a]Experiment 1. [b]Experiment 2.

Table 4

Average Vividness Ratings as a Function of Image Type, Conditions, and Testing

	Conditions		
Testing	Pictorial	Concealed	Separate
Immediate[a]			
Normal	2.34	2.72	2.90
Bizarre	3.10	4.18	3.94
Delayed[b]			
Normal	1.89	3.74	3.54
Bizarre	2.85	4.03	4.55

Note. Most vivid = 1.00; Least vivid = 7.00.

[a]Experiment 1. [b]Experiment 2.